US009315096B2

(12) **United States Patent**
Ahn et al.

(10) **Patent No.: US 9,315,096 B2**
(45) **Date of Patent: Apr. 19, 2016**

(54) **TRANSMISSION SYSTEM OF HYBRID ELECTRIC VEHICLE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/253,414**

(22) Filed: **Apr. 15, 2014**

(65) **Prior Publication Data**

US 2015/0114175 A1 Apr. 30, 2015

(30) **Foreign Application Priority Data**

Oct. 28, 2013 (KR) 10-2013-0128689

(51) **Int. Cl.**
B60K 6/42 (2007.10)

(52) **U.S. Cl.**
CPC ***B60K 6/42*** (2013.01); *Y10T 74/19014* (2015.01)

(58) **Field of Classification Search**
CPC F16H 1/22; F16H 37/00; F16H 2700/02; F16H 2700/06; B60K 6/36; B60K 6/387
USPC .... 74/661, 664, 665 R, 665 A, 665 B; 180/65.21, 65.22, 65.25; 903/951
See application file for complete search history.

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(57) **ABSTRACT**

A transmission system of a hybrid electric vehicle may include a first shaft connected to an engine, a first hollow shaft disposed without rotational interference with the first shaft, selectively connected to the first shaft, and provided with a first output gear, a second hollow shaft disposed without rotational interference with the first hollow shaft and provided with a second output gear, a second shaft disposed in parallel with the first shaft and connected to the first shaft through a gear unit, a clutch selectively connecting the first shaft to the first hollow shaft, a first motor/generator operably connected to the second hollow shaft, and a second motor/generator operably connected to the second shaft.

8 Claims, 5 Drawing Sheets

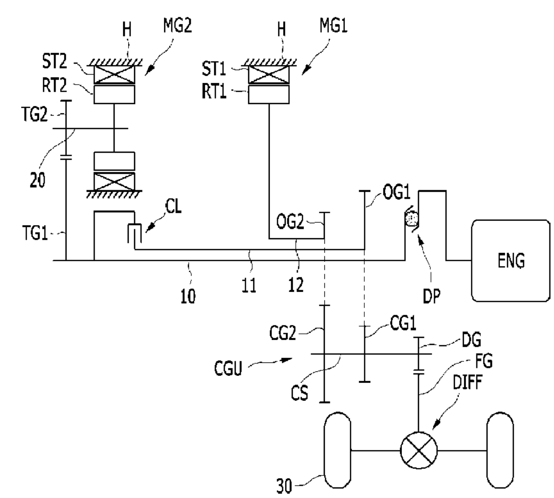

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FIG. 1

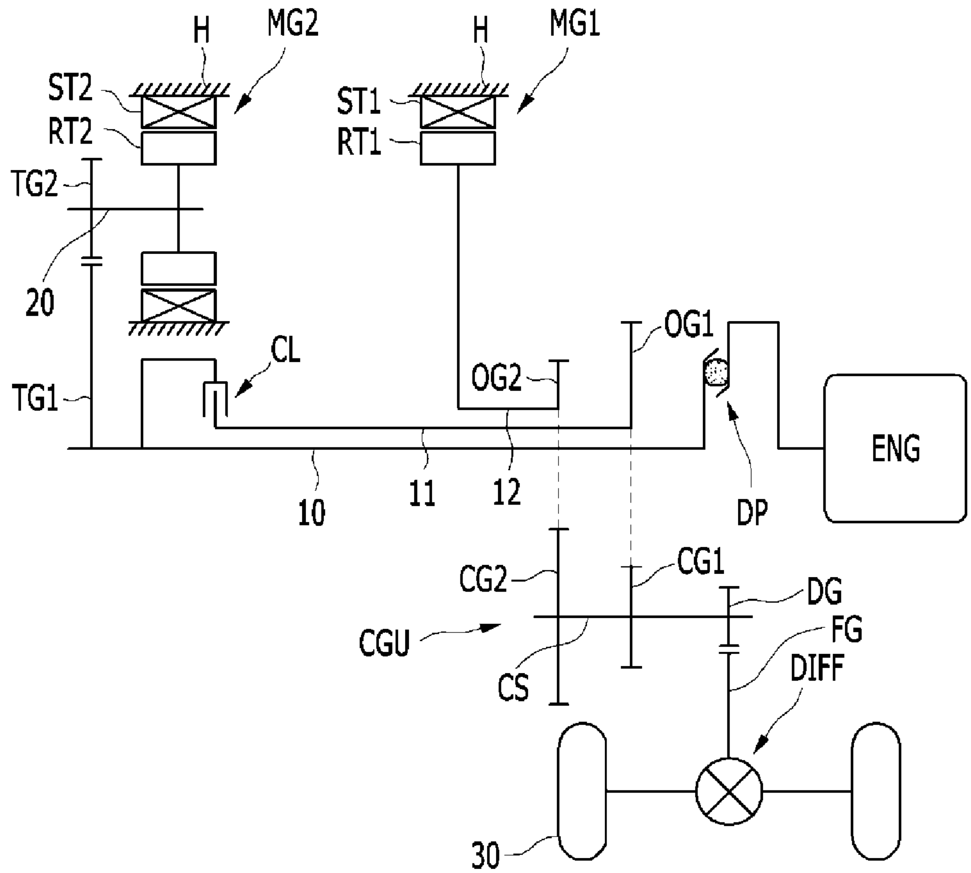

H
MG2
H
MG1
ST2
RT2
ST1
RT1
TG2
20
OG1
CL
OG2
TG1
ENG
10
11
12
DP
CG1
CG2
DG
FG
CGU
DIFF
CS
30

FIG. 2

Drive mode	CL
EV mode	
Starting of engine	
Continuous mode	
Direct-coupling of parallel mode (including ud, 1:1, od)	○

FIG. 3

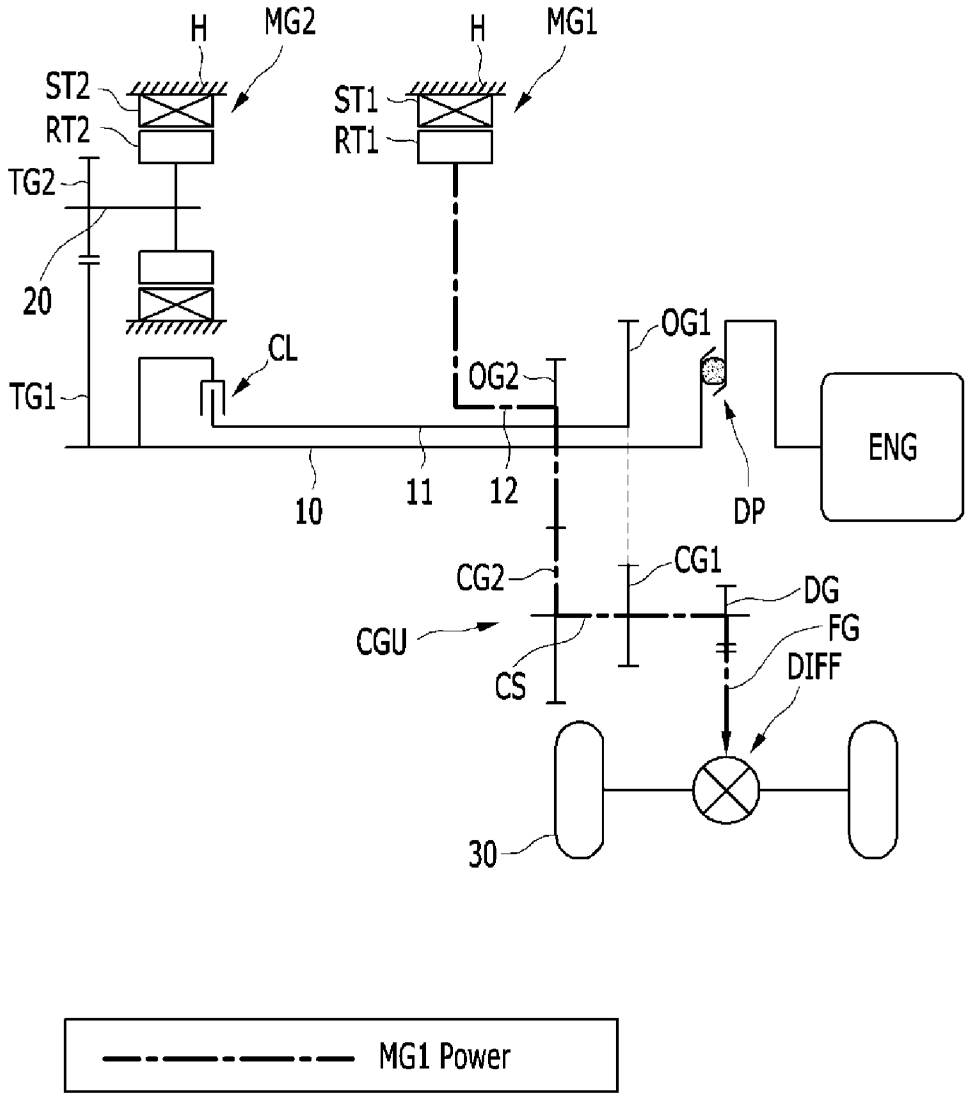

H
MG2
H
MG1
ST2
RT2
ST1
RT1
TG2
20
OG1
CL
OG2
TG1
ENG
10
11
12
DP
CG2
CG1
DG
FG
CGU
DIFF
CS
30
MG1 Power

FIG. 4

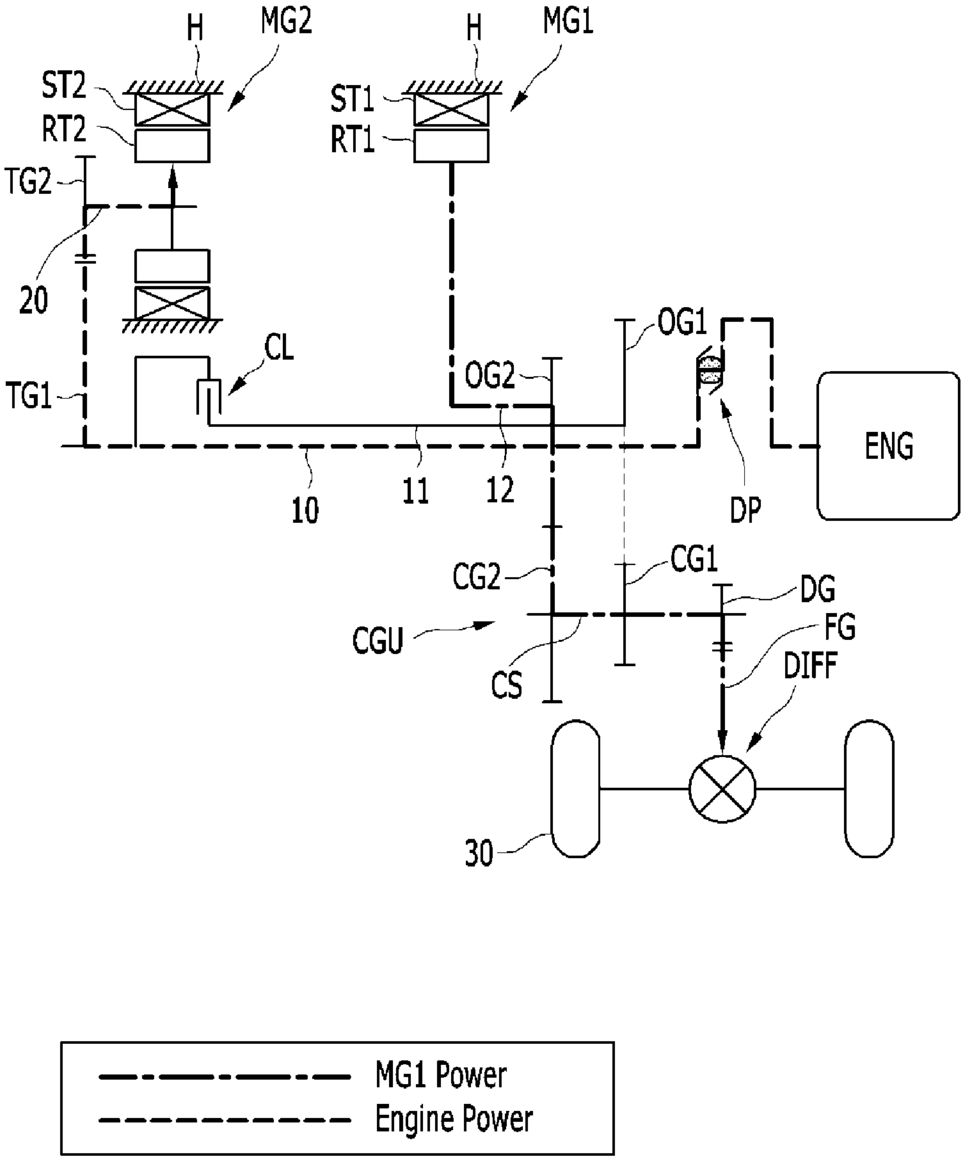
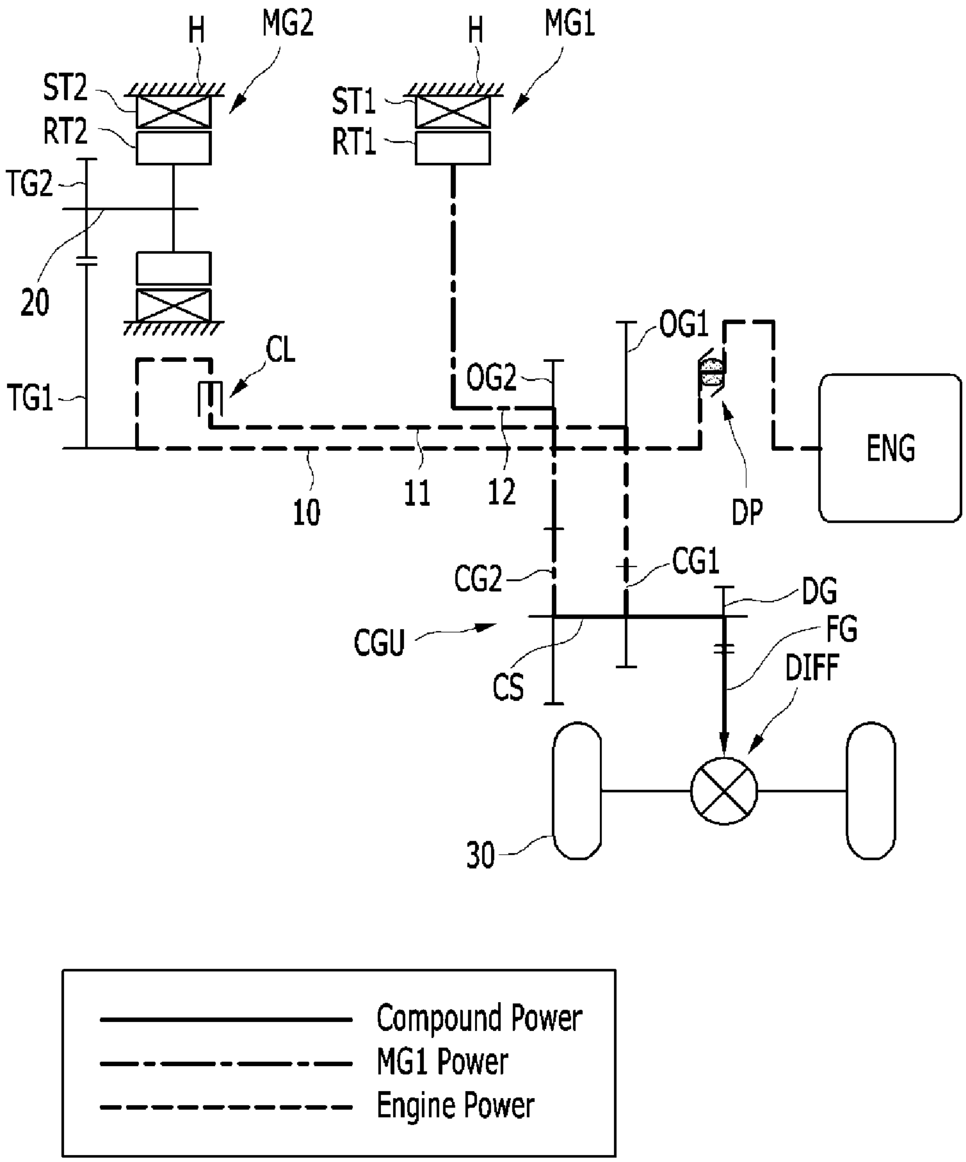

H
MG2
H
MG1
ST2
RT2
ST1
RT1
TG2
20
TG1
CL
OG2
OG1
ENG
10
11
12
DP
CG2
CG1
DG
FG
DIFF
CGU
CS
30
MG1 Power
Engine Power

FIG. 5


H
MG2
H
MG1
ST2
RT2
ST1
RT1
TG2
20
TG1
CL
OG2
OG1
ENG
DP
10
11
12
CG2
CG1
DG
FG
DIFF
CGU
CS
30
Compound Power
MG1 Power
Engine Power

TRANSMISSION SYSTEM OF HYBRID ELECTRIC VEHICLE

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims priority of Korean Patent Application Number 10-2013-0128689 filed on Oct. 28, 2013, the entire contents of which application are incorporated herein for all purposes by this reference.

BACKGROUND OF INVENTION

1. Field of Invention

The present invention relates to a transmission system of a hybrid electric vehicle. More particularly, the present invention relates to a transmission system of a hybrid electric vehicle that can achieve electric vehicle (EV) mode, continuous mode and parallel mode including direct-coupling.

2. Description of Related Art

Generally, a hybrid vehicle is a vehicle which uses two different power sources efficiently. Such a hybrid electric vehicle typically uses an engine and a motor/generator. The hybrid electric vehicle uses the motor/generator having relatively better low-speed torque characteristics as a main power source at a low-speed and uses an engine having relatively better high-speed torque characteristics as a main power source at a high-speed. Since the hybrid electric vehicle stops operation of the engine using the fossil fuel and uses the motor/generator at a low-speed region, fuel consumption may be improved and exhaust gas may be reduced.

The power transmission system of a hybrid electric vehicle is classified into a single-mode type and a multi-mode type.

A torque delivery apparatus such as clutches and brakes for shift control is not necessary, but fuel consumption is high due to deterioration of efficiency at a high-speed region and an additional torque multiplication device is required for being applied to a large vehicle according to the single-mode type.

Since the multi-mode type has high efficiency at the high-speed region and is able to multiply torque autonomously, the multi-mode type can be applied to a full size vehicle. Therefore, the multi-mode type instead of the single-mode type is applied as the power transmission system of a hybrid electric vehicle and is also under continuous investigation.

The power transmission system of the multi-mode type includes a plurality of planetary gear sets, a plurality of motor/generators operated as a motor and/or a generator, a plurality of torque delivery apparatus controlling rotation elements of the planetary gear sets, and a battery used as a power source of the motor/generators.

The power transmission system of the multi-mode type has different operating mechanisms depend on connections of the planetary gear sets, the motor/generators, and the torque delivery apparatus. In addition, the power transmission system of the multi-mode type has different features such a durability, power delivery efficiency, and size depend on the connections of the planetary gear sets, the motor/generators, and the torque delivery apparatus. Therefore, designs for the connection structure of the power transmission system of a hybrid electric vehicle are also under continuous investigation to achieve robust and compact power transmission system having no power loss.

The information disclosed in this Background section is only for enhancement of understanding of the general background of the invention and should not be taken as an acknowledgement or any form of suggestion that this information forms the prior art already known to a person skilled in the art.

SUMMARY OF INVENTION

The present invention has been made in an effort to provide a transmission system of a hybrid electric vehicle having advantages of achieving EV mode, continuous mode and parallel mode including direct-coupling by disposing two motor/generators and one clutch on a first shaft.

In addition, the present invention has been made in an effort to provide a transmission system of a hybrid electric vehicle having further advantages of enhancing fuel economy as a consequence of not using a clutch at modes other than parallel mode when driving.

In addition, the present invention has been made in an effort to provide a transmission system of a hybrid electric vehicle having further advantages of reducing capacity of a motor/generator for driving as well as enhancing fuel economy since continuous mode is unnecessary at high-speed region by adding parallel mode including direct-coupling.

In addition, the present invention has been made in an effort to provide a transmission system of a hybrid electric vehicle having further advantages of shortening a length of the transmission system by disposing a motor/generator for generating on a second shaft and disposing the clutch in a space secured by removing a planetary gear set.

A transmission system of a hybrid electric vehicle according to various aspects of the present invention may include a first shaft connected to an engine, a first hollow shaft disposed without rotational interference with the first shaft, selectively connected to the first shaft, and provided with a first output gear, a second hollow shaft disposed without rotational interference with the first hollow shaft and provided with a second output gear, a second shaft disposed in parallel with the first shaft and connected to the first shaft through a gear unit, a clutch selectively connecting the first shaft to the first hollow shaft, a first motor/generator operably connected to the second hollow shaft, and a second motor/generator operably connected to the second shaft.

The transmission system may further include a reduction gear unit transmitting torque of the first hollow shaft or the second hollow shaft to a differential apparatus. The reduction gear unit may include an intermediate shaft disposed between the first shaft and the differential apparatus and in parallel with the first shaft, a first intermediate gear provided on the intermediate shaft and engaged with the first output gear, a second intermediate gear provided on the intermediate shaft and engaged with the second output gear, and a drive gear provided on the intermediate shaft and engaged with a final reduction gear of the differential apparatus.

The gear unit may include a first externally-meshing gear disposed on the first shaft, and a second externally-meshing gear provided on the second shaft and engaged with the first externally-meshing gear. The clutch may be disposed between the first shaft and the first hollow shaft. The transmission system may further include a damper disposed between the engine and the first shaft.

A transmission system of a hybrid electric vehicle according to various other aspects of the present invention may include a first shaft connected to an engine, a first hollow shaft disposed without rotational interference with the first shaft and selectively connected to the first shaft, a second hollow shaft disposed without rotational interference with the first hollow shaft, a second shaft disposed in parallel with the first shaft, first and second output gears disposed respectively on the first and second hollow shafts and respectively outputting torques of the first and second hollow shafts, a gear unit disposed between the first shaft and the second shaft and transmitting torque between the first shaft and the second shaft, a clutch selectively connecting the first shaft to the first hollow shaft, a first motor/generator operably connected to the second hollow shaft, and a second motor/generator operably connected to the second shaft.

The transmission system may further include a reduction gear unit transmitting the torque of the first hollow shaft or the second hollow shaft to a differential apparatus. The reduction gear unit may include an intermediate shaft disposed between the first shaft and the differential apparatus and in parallel with the first shaft, a first intermediate gear provided on the intermediate shaft and engaged with the first output gear, a second intermediate gear provided on the intermediate shaft and engaged with the second output gear, and a drive gear provided on the intermediate shaft and engaged with a final reduction gear of the differential apparatus.

The gear unit may include a first externally-meshing gear disposed on the first shaft, and a second externally-meshing gear provided on the second shaft and engaged with the first externally-meshing gear. The clutch may be disposed between the first shaft and the first hollow shaft. The transmission system may further include a damper disposed between the engine and the first shaft.

A transmission system of a hybrid electric vehicle according to still various other aspects of the present invention may include a first shaft connected to an engine a first hollow shaft disposed without rotational interference with the first shaft and selectively connected to the first shaft, a second hollow shaft disposed without rotational interference with the first hollow shaft, a second shaft disposed in parallel with the first shaft, first and second output gears disposed respectively on the first and second hollow shafts and respectively outputting torques of the first and second hollow shafts, a gear unit disposed between the first shaft and the second shaft and transmitting torque between the first shaft and the second shaft, a clutch disposed between the first shaft and the first hollow shaft, a first motor/generator operably connected to the second hollow shaft, a second motor/generator operably connected to the second shaft, and a reduction gear unit transmitting the torque of the first hollow shaft or the second hollow shaft to a differential apparatus.

The gear unit may include a first externally-meshing gear disposed on the first shaft, and a second externally-meshing gear provided on the second shaft and engaged with the first externally-meshing gear. The reduction gear unit may include: an intermediate shaft disposed between the first shaft and the differential apparatus and in parallel with the first shaft, a first intermediate gear provided on the intermediate shaft and engaged with the first output gear, a second intermediate gear provided on the intermediate shaft and engaged with the second output gear, and a drive gear provided on the intermediate shaft and engaged with a final reduction gear of the differential apparatus. The transmission system may further include a damper disposed between the engine and the first shaft.

The methods and apparatuses of the present invention have other features and advantages which will be apparent from or are set forth in more detail in the accompanying drawings, which are incorporated herein, and the following Detailed Description, which together serve to explain certain principles of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram of an exemplary transmission system of a hybrid electric vehicle according to the present invention.

FIG. **2** is an operational chart of friction elements at each mode applied to an exemplary transmission system of a hybrid electric vehicle according to the present invention.

FIG. **3** is a schematic diagram for illustrating flow of power at EV mode in an exemplary transmission system of a hybrid electric vehicle according to the present invention.

FIG. **4** is a schematic diagram for illustrating flow of power at continuous mode in an exemplary transmission system of a hybrid electric vehicle according to the present invention.

FIG. **5** is a schematic diagram for illustrating flow of power at direct-coupling of parallel mode in an exemplary transmission system of a hybrid electric vehicle according to the present invention.

DETAILED DESCRIPTION

Reference will now be made in detail to various embodiments of the present invention(s), examples of which are illustrated in the accompanying drawings and described below. While the invention(s) will be described in conjunction with exemplary embodiments, it will be understood that present description is not intended to limit the invention(s) to those exemplary embodiments. On the contrary, the invention(s) is/are intended to cover not only the exemplary embodiments, but also various alternatives, modifications, equivalents and other embodiments, which may be included within the spirit and scope of the invention as defined by the appended claims.

Description of components that are not necessary for explaining the present exemplary embodiment will be omitted, and the same constituent elements are denoted by the same reference numerals in this specification. In the detailed description, ordinal numbers are used for distinguishing constituent elements having the same terms, and have no specific meanings.

FIG. **1** is a schematic diagram of a transmission system of a hybrid electric vehicle according to various embodiments of the present invention. Referring to FIG. **1**, a transmission system of a hybrid electric vehicle according to various embodiments of the present invention changes torques of an engine ENG and first and second motor/generators MG1 and MG2 according to running state of a vehicle and outputs the changed torque through first and second output gears OG1 and OG2.

The transmission system includes a first shaft **10**, first and second hollow shafts **11** and **12**, the first and second motor/generators MG1 and MG2, a second shaft **20**, a clutch CL, and a reduction gear unit CGU.

One side of the first shaft **10** is connected to an output side of the engine ENG such that the first shaft **10** receives driving torque of the engine. In some embodiments of the present invention, a damper DP for absorbing bending impact is disposed between the output side of the engine ENG and the one side of the first shaft **10**.

In addition, the first and second hollow shafts **11** and **12** are disposed at a radial outside of the first shaft **10**. The first shaft **10** and the first and second hollow shafts **11** and **12** are so arranged that rotational interference does not occur among the first shaft **10** and the first and second hollow shafts **11** and **12**.

A first output gear OG1 is mounted at an end of the first hollow shaft **11** and a second output gear OG2 is mounted at an end of the second hollow shaft **12**. In addition, the first output gear OG1 and the second output gear OG2 are spaced axially by a predetermined distance, and a diameter of the first output gear OG1 is relatively larger than that of the second output gear OG2.

The first motor/generator MG1 and the second motor/generator MG2 are independent power sources and are operated as a motor and a generator. The first motor/generator MG1 includes a first rotor RT1 and a first stator ST1. The first rotor RT1 is connected to the second hollow shaft **12** and the first stator ST1 is fixed to a transmission housing H such that the first motor/generator MG1 is used as a motor for driving the vehicle.

The second motor/generator MG2 includes a second rotor RT2 and a second stator ST2. The second rotor RT2 is connected to a side of the second shaft **20** and the second stator ST2 is fixed to the transmission housing H such that the second motor/generator MG2 is used as a generator.

The second shaft **20** is disposed in parallel or substantially in parallel with and apart from the first shaft **10** and is operably connected to the first shaft **10** through a gear unit. Therefore, the second shaft **20** receives torque from the first shaft **10** or transmits torque to the first shaft **10**.

Herein, the gear unit includes a first externally-meshing gear TG1 mounted at the other side of the first shaft **10** and a second externally-meshing gear TG2 mounted at the other side of the second shaft **20** and engaged with the first externally-meshing gear TG1.

In addition, the clutch CL is adapted to transmit torque and is disposed in a space formed between the first shaft **10** and the second shaft **20**. The clutch CL is disposed between the first shaft **10** and the first hollow shaft **11** and selectively connects the first shaft **10** with the first hollow shaft **11**. If the clutch CL is operated, the first shaft **10** and the first hollow shaft **11** are connected such that rotation speed of the engine ENG is directly input to the first output gear OG1. The clutch CL may be a conventional multi-plate friction element of wet type that is operated by hydraulic pressure, and selectively connects a rotation element with another rotation element.

In addition, the first and second output gears OG1 and OG2 are connected to a final reduction gear FG of a differential apparatus DIFF through a reduction gear unit CGU. The reduction gear unit CGU decreases rotation speeds of the first and second output gears OG1 and OG2 and transmits the decreased rotation speeds to the final reduction gear FG.

The reduction gear unit CGU includes an intermediate shaft CS disposed in parallel or substantially in parallel with the first shaft **10** between the first shaft **10** and the differential apparatus DIFF. In addition, the reduction gear unit CGU further includes a first intermediate gear CG1 disposed on the intermediate shaft CS and engaged with the first output gear OG1, a second intermediate gear CG2 disposed on the intermediate shaft CS and engaged with the second output gear OG2, and a drive gear DG disposed on the intermediate shaft CS and engaged with the final reduction gear FG of the differential apparatus DIFF. The first intermediate gear CG1, the second intermediate gear CG2 and the drive gear DG are disposed in a sequence of the drive gear DG, the first intermediate gear CG1 and the second intermediate gear CG2.

Since diameters of the first and second intermediate gears CG1 and CG2 are larger than that of the drive gear DG, the reduction gear unit CGU decreases rotation speeds of the first and second output gears OG1 and OG2 and transmits the decreased rotation speed to the final reduction gear FG. Thereby, the driving wheel **30** is driven.

The transmission system of the hybrid electric vehicle according to various embodiments of the present invention includes a power delivery path through which driving torque of the first motor/generator MG1 is transmitted to the driving wheel **30** so as to run the vehicle, and a power delivery path through which the driving torque of the engine ENG is transmitted to the driving wheel **30** so as to run the vehicle. Therefore, the transmission system runs the vehicle by using any one of the two power delivery paths or both of the power delivery paths selectively.

Herein, clutch CL is operated so as to connect the first shaft **10** with the first hollow shaft **11** if the driving torque of the engine ENG is transmitted to the driving wheel **30**.

FIG. **2** is an operational chart of friction elements at each mode applied to a transmission system of a hybrid electric vehicle according to various embodiments of the present invention. Referring to FIG. **2**, the transmission system of the hybrid electric vehicle according to various embodiments of the present invention can achieve EV mode, continuous mode, and parallel mode including direct-coupling.

That is, the clutch CL is released at the EV mode and the continuous mode, and the clutch CL is operated at the direct-coupling of the parallel mode. At this time, under drive, direct-coupling drive and over drive can be achieved according to gear ratios of the first intermediate gear CG1 of the reduction gear unit CGU engaged with the first output gear OG1 and the drive gear DG at the direct-coupling of the parallel mode.

Hereinafter, flow of torque at each mode in the transmission system of the hybrid electric vehicle according to various embodiments of the present invention will be described, referring to FIG. **3** to FIG. **5**.

FIG. **3** is a schematic diagram for illustrating flow of power at EV mode in a transmission system of a hybrid electric vehicle according to various embodiments of the present invention. Referring to FIG. **3**, clutch CL is released at the EV mode.

At the EV mode, the engine ENG is stopped and the driving torque of the first motor/generator MG1 is transmitted to the final reduction gear FG of the differential apparatus DIFF through the second hollow shaft **12**, the second output gear OG2, the second intermediate gear CG2, the intermediate shaft CS, and the drive gear DG. At this process, the rotation speed of the first motor/generator MG1 decreases. That is, the driving wheel **30** is driven by the driving torque of the first motor/generator MG1 at the EV mode. Therefore, electrically continuously variable shift may be achieved by controlling the rotation speed of the first motor/generator MG1.

FIG. **4** is a schematic diagram for illustrating flow of power at continuous mode in a transmission system of a hybrid electric vehicle according to various embodiments of the present invention. Referring to FIG. **4**, the clutch CL is released at the continuous mode.

If the engine ENG is started at the EV mode, the continuous mode is achieved. At the continuous mode, the driving torque of the engine ENG is transmitted to the second motor/generator MG2 through the first shaft **10** and the second shaft **20**. At this process, the rotation speed of the engine ENG increases. In addition, electricity generated by the second motor/generator MG2 is supplied to the first motor/generator MG1 as drive power at the continuous mode.

At this time, the engine ENG is started by the second motor/generator MG2. That is, even though the engine ENG is operated, the driving torque of the engine ENG is not directly transmitted to the driving wheel **30** but is transmitted to the second motor/generator MG2 such that the second motor/generator MG2 generates the electricity.

Meanwhile, the second motor/generator MG2 is operated such that the driving torque of the second motor/generator MG2 is transmitted to the engine ENG through the second externally-meshing gear TG2 on the second shaft **20**, the first externally-meshing gear TG1 on the first shaft **10**, and first shaft **10** when the engine ENG is started. Therefore, starting of the engine ENG is achieved. At this process, the rotation speed of the second motor/generator MG2 decreases.

After the engine ENG is started, the second motor/generator MG2 does not operate and generates electricity by the torque of the engine ENG.

The driving torque of the first motor/generator MG1 is transmitted to the final reduction gear FG of the differential apparatus DIFF through the second hollow shaft **12**, the second output gear OG2, the second intermediate gear CG2, the intermediate shaft CS, and the drive gear DG at the continuous mode, the same as the EV mode. At this process, the rotation speed of the first motor/generator MG1 decreases. That is, the driving wheel **30** is driven by the driving torque of the first motor/generator MG1 at the continuous mode. In addition, electrically continuously variable shift may be achieved by controlling the rotation speed of the first motor/generator MG1.

At this time, the first motor/generator MG1 uses the electricity generated by the second motor/generator MG2 as the drive power. In addition, remaining electricity is charged in the battery.

FIG. **5** is a schematic diagram for illustrating flow of power at direct-coupling of parallel mode in a transmission system of a hybrid electric vehicle according to various embodiments of the present invention. Referring to FIG. **5**, clutch CL is operated at the direct-coupling of the parallel mode.

The torque of the engine ENG is used as main power and the torque of the first motor/generator MG1 is used as auxiliary power at the direct-coupling of the parallel mode. That is, the torque of the engine ENG is supplied as the main power to the first output gear OG1 through the first shaft **10** by operation of the clutch CL, and the torque of the first motor/generator MG1 is transmitted to the second output gear OG2 as the auxiliary power.

At this time, a portion of the torque of the engine ENG may be involved in the power generation of the second motor/generator MG2. The electrically continuously variable shift may be achieved by the torque of the engine ENG transmitted to the first output gear OG1 through the first shaft **10** and the first hollow shaft **11** and the torque of the first motor/generator MG1 transmitted to the second output gear OG2 through the second hollow shaft **12** at the direct-coupling of the parallel mode.

As described above, the torques of the engine ENG and the first motor/generator MG1 input to the first and second output gears OG1 and OG2 are transmitted to the final reduction gear FG of the differential apparatus DIFF through the first and second intermediate gears CG1 and CG2 and the drive gear DG. That is, the driving wheel **30** is driven by the driving torques of the engine ENG and the first motor/generator MG1 at the direct-coupling of the parallel mode.

As described above, all of the engine ENG, the first motor/generator MG1 and the second motor/generator MG2 can generate driving torque, the second motor/generator MG2 can generate electricity by using the torque of the engine ENG, and continuous gear ratios required in the vehicle can be formed by control of the first motor/generator MG1 in the transmission system of the hybrid electric vehicle according to various embodiments of the present invention. Therefore, fuel economy may be improved.

That is, the EV mode, the continuous mode and the parallel mode including the direct-coupling can be achieved by disposing two motor/generators MG1 and MG2 and one clutch CL on the first shaft **10**. In addition, since the clutch is not used at modes other than the parallel mode, operating pressure applied to the clutches can be minimized and fuel economy may be improved. In addition, since the direct-coupling is added in the parallel mode, fuel economy may be enhanced and capacity of the first motor/generator MG1 may be reduced. In addition, since the second motor/generator MG2 for generating electricity is disposed on the second shaft **20** and the clutch CL is disposed in the space attained by removing the planetary gear set, a length of the transmission system may be shortened.

The foregoing descriptions of specific exemplary embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teachings. The exemplary embodiments were chosen and described in order to explain certain principles of the invention and their practical application, to thereby enable others skilled in the art to make and utilize various exemplary embodiments of the present invention, as well as various alternatives and modifications thereof. It is intended that the scope of the invention be defined by the Claims appended hereto and their equivalents.

What is claimed is:

1. A transmission system of a hybrid electric vehicle comprising:

a first shaft connected to an engine and provided with a first externally-meshing gear fixedly disposed on the first shaft;

a first hollow shaft disposed without rotational interference with the first shaft, selectively connectable to the first shaft through a clutch, and provided with a first output gear fixedly disposed on the first hollow shaft;

a second hollow shaft disposed without rotational interference with the first hollow shaft and provided with a second output gear fixedly disposed on the second hollow shaft, wherein the first shaft is positioned through the first hollow shaft to form a combination, and the combination of the first shaft and the first hollow shaft are positioned through the second hollow shaft;

a second shaft disposed in parallel with the first shaft and provided with a second externally-meshing gear fixedly disposed on the second shaft and engaged with the first externally-meshing gear;

a first motor/generator directly and operably connected to the second hollow shaft;

a second motor/generator directly and operably connected to the second shaft; and

a reduction gear unit transmitting torque of the first hollow shaft or the second hollow shaft to a differential apparatus.

2. The transmission system of claim **1**, wherein the clutch is disposed between the first shaft and the first hollow shaft.

3. The transmission system of claim **1**, further comprising a damper disposed between the engine and the first shaft.

4. A transmission system of a hybrid electric vehicle comprising:

a first shaft connected to an engine and provided with a first externally-meshing gear fixedly disposed on the first shaft;

a first hollow shaft disposed without rotational interference with the first shaft and selectively connectable to the first shaft through a clutch;

a second hollow shaft disposed without rotational interference with the first hollow shaft, wherein the first shaft is positioned through the first hollow shaft to form a combination, and the combination of the first shaft and the first hollow shaft are positioned through the second hollow shaft;

a second shaft disposed in parallel with the first shaft and provided with a second externally-meshing gear fixedly disposed on the second shaft and engaged with the first externally-meshing gear;

first and second output gears fixedly disposed respectively on the first and second hollow shafts and respectively outputting torques of the first and second hollow shafts;

a first motor/generator directly and operably connected to the second hollow shaft;

a second motor/generator directly and operably connected to the second shaft; and

a reduction gear unit transmitting the torque of the first hollow shaft or the second hollow shaft to a differential apparatus.

5. The transmission system of claim **4**, wherein the clutch is disposed between the first shaft and the first hollow shaft.

6. The transmission system of claim **4**, further comprising a damper disposed between the engine and the first shaft.

7. A transmission system of a hybrid electric vehicle comprising:

a first shaft connected to an engine and provided with a first externally-meshing gear fixedly disposed on the first shaft;

a first hollow shaft disposed without rotational interference with the first shaft and selectively connectable to the first shaft through a clutch;

a second hollow shaft disposed without rotational interference with the first hollow shaft;

a second shaft disposed in parallel with the first shaft and provided with a second externally-meshing gear fixedly disposed on the second shaft and engaged with the first externally-meshing gear;

first and second output gears fixedly disposed respectively on the first and second hollow shafts and respectively outputting torques of the first and second hollow shafts;

a first motor/generator directly and operably connected to the second hollow shaft;

a second motor/generator directly and operably connected to the second shaft; and

a reduction gear unit transmitting the torque of the first hollow shaft or the second hollow shaft to a differential apparatus,

wherein the first shaft is positioned through the first hollow shaft to form a combination, and the combination of the first shaft and the first hollow shaft are positioned through the second hollow shaft.

8. The transmission system of claim **7**, further comprising a damper disposed between the engine and the first shaft.

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